ON THE TRANSITION OF AEDES TOBOI THEOB. AND AEDES JAPONICUS THEOB. (DIPTERA, CULICIDAE) TO A SYNANTHROPIC FORM OF LIFE

AD648125
TT67-61220

Translation No. 1743

DECEMBER 1966

U. S. ARMY
BIOLOGICAL LABORATORIES
FORT DETRICK, FREDERICK, MARYLAND

DDC
RELEASED
MAR 14 1967
C

ARCHIVE COPY

ON THE TRANSITION OF AEDES TOGOI THEOB. AND AEDES JAPONICUS THEOB. (DIPTERA, CULICIDAE) TO A SYNANTHROPIC FORM OF LIFE

Following is the translation of an article by P. A. Petrishcheva, Department of Parasitology and Medical Zoology, Institute of Bacteriology, Epidemiology and Infectious Diseases, USSR Academy of Medical Sciences, Moscow, published in the Russian-language periodical Entomologicheskoye Obozreniye (Entomological Review), Vol XXX, 1948, No 1--2, pages 103--108. Translation performed by Sp/7 Charles T. Ostertag, Jr.

Aedes togoi Theob. and Ae. japonicus Theob. are the main carriers of Japanese encephalitis both in Japan and in our southern Primorye.

In addition to its scientific value, a study of the biology and ecology of both species also has a great practical importance for founding a system of antimosquitoe measures in foci of Japanese encephalitis. In southern Primorye each of these species is the carrier of Japanese encephalitis for a specific landscape zone. According to our data Ae. togoi Theob. is widely distributed on the rocky coast of the Japanese and Yellow Seas. Ae. japonicus Theob. is the main carrier of Japanese encephalitis in the forest zone and has been studied by us in the region of resort settlements and rural localities from Razdolnoye to Vladivostok and partially in the region of the Kedrovaya Pad [a narrow, deep valley or ravine with a small stream running along the bottom].

The biological peculiarities of these species are expressed most extremely in regions which have been mastered by man. However, the economic activity of man, who is mastering the virgin territory, is a leading factor in determining the further bioecology of these species and in the end result leading them to a synanthropic form of life. In the new situation these species completely lose those peculiarities which are inherent to them in the first stages and become the typical fellow travelers of man and farm animals. We were able to observe all the phases of the transition of these species to the condition of synanthropes during a visit to the Soviet Far East, North Korea, and Southern Manchuria. In the present article we will elucidate this problem briefly.

Natural Habitats of Aedes togoi Theob. and Aedes japonicus Theob.

The vast spaces of the rocky shore of the Yellow and Japanese Seas are the habitat for Ae. togoi Theob. In southern Primorye we followed its characteristic places up to Cape Olga, which apparently is not the northern

limit of its distribution. These places are not too practicable for settling by man and are the habitats for sea birds -- sea gulls, cormorants, and others. Sea birds are the main hosts for Ae. togoi Theob. and determine the degree of abundance of the mosquitoes; if the rocky sectors are suitable places for the nesting and resting of birds, then the latter settle here in great numbers; if there is a sufficient presence of larval biotopes here a great number of mosquitoes, the carriers, develops. All kinds of pools and small water reservoirs here are breeding sites for Ae. togoi Theob. The bare rocky sectors further the rapid and intense heating up of the water, which in its turn creates more favorable conditions for the development of the offspring of the mosquitoes. In places along the shore of the Japanese Sea it is possible to observe an exceptional concentration of Ae. togoi Theob. in a limited territory. The nesting sites for sea birds on Furugelma Island represent an especially expressed example of this. Here each water reservoir, regardless of size, depth, light exposure, or if it is not heated, is abundantly settled with larvae and pupae of Ae. togoi Theob. Hungry females attack man so insistently, that the necessary collecting of material and observations here are made difficult to the extreme.

Larval and imago (the adult and sexually developed inset) phases of Ae. togoi Theob. may also be found in places which are little suitable for their mass development and which are not visited by sea birds, where this species utilizes any possibility for settling; its larvae may live in small reservoirs of the narrow deep crevice type, which are filled with a small layer of water, often in strongly shaded, cool spots. Apparently the imago phase may select for feeding, in addition to birds, other accidental prey.

Atypical landscape for the habitat of Ae. japonicus Theob. is the taiga zone with tall arboreal vegetation. We did not have one finding of mosquitoes of this species in the vast treeless territory of southern Primorye, where we worked for four summer seasons. In the unsettled forest zone Ae. japonicus Theob. is encountered rarely but constantly. We found its larvae once in the Kedrovaya Pad in a small water reservoir of the root hallow type in an old partially decomposed stump. Individual starving females were encountered only with the mass collections of forest mosquitoes, especially during field trips into the forest and spending the night with the special purpose of collecting winged mosquitoes. A sparse distribution is characteristic for Ae. japonicus Theob. in the vast forest territory with a very low rate of encounter.

Initial Economic Stations

A huge role is acquired by the anthropogenic factor in the distribution of both species. The first appearance of man close to their habitats already introduces a significant change in the behavior of these mosquitoes. Being a large and more accessible prey, man furthers the rapid concentration of both species among himself. In the tents of the fishing brigades, which leave out for seasonal work at the sea shore, and also at the field camps for

workers engaged in mining rocks for construction material, we already encountered the first signs of the transition of Ae. togoi Theob. to feeding on the blood of man. This is influenced more yet by the proximity of the natural sites and for the present the partial bond of the mosquitoe with man. The winged mosquitoes fly into the habitations of man only for blood sucking. The settling of man on the sea coast for permanent residence leads to a more profound bond between Ae. togoi Theob. and the new hosts. The initial stages in the transition of the wild mosquitoe to a synanthropic form of life may be observed especially clearly in the small territories in the locality of lighthouses which have been settled by man. Several living quarters and outbuildings, especially with the presence in them of 1--2 cows or horses, are the first economic stations for Ae. togoi Theob. Here the mosquitoe remains for permanent residence, selecting artificial water reservoirs for breeding, and for daytime resting places -- outdoor structures. Nevertheless the proximity of natural stations quite significantly influences the abundance of mosquitoes in the abode of man. Here, with sufficient sources of nourishment the possibilities of breeding progeny may be very limited, which is conditioned by the partial or complete utilization by the mosquitoes of the ordinary reservoirs on the shore of the sea but with the primary concentration of winged mosquitoes in the territory occupied by man. In such cases in the initial economic biotopes Ae. togoi Theob. reaches very large numbers (the light house opposite Posyet). We also observed the partial transition of Ae. togoi Theob. to a synanthropic form of life in the comparatively small village of Zarubino. Here, along with the mass breeding of mosquitoes on the rocky stations, individual larvae were encountered in artificial water reservoirs.

The transition of Ae. japonicus Theob. to a synanthropic form of life is also accomplished gradually. However, the role of man in its concentration comes out significantly more obviously. As was stated above, a peculiarity of this mosquitoe is the very small numerical strength in natural stations, but its territorial dispersion is apparently less limited. In places we were not successful at all in detecting Ae. japonicus Theob. by the usual methods of collecting mass material. But the first temporary abode for man in the forest is the same as a "trap" for this species. With the help of this trap it is possible to establish its presence in places of its assumed distribution (forest stores in the region of Poltavka). The more settled, but nevertheless temporary residence of worker's collectives in the forest, is a further step toward the accumulation of this species of mosquitoe close to man. In the summer of 1945 in the forest zone of Kedrovaya Pad we visited the site of a small worker's collective for the exploitation of useful minerals. Here more than 30 artificial water reservoirs were created which turned out to be breeding sites for Ae. japonicus Theob. The two-summer residence in the forest of several dozen workers led to the exceedingly intense multiplication here of this mosquito. The walls of the artificial water reservoirs were uniformly covered with its eggs. This made it possible for us, by means of scraping, to collect them in a hugh quantity for the purpose of maintaining a constant culture of this species in the laboratory in Moscow. This we achieved easily. In 1939 in

the forest zone in the region of Razdolnyy village we encountered a small abandoned plant of the domestic type for the processing of coal. Here we found two metal tanks with water and several other artificial water reservoirs with individual larvae of Ae. japonicus Theob. In 1940 two families of the forest guard settled in this sector, and together with them domestic cattle appeared. In the end of September in the stated water reservoirs we detected a multitude of larvae and pupae, in spite of the late period of the investigation. On the basis of this we assume that with the complete departure of man from the forest Ae. japonicus Theob. again returns to the usual form of life, almost abandoning the larval biotopes due to the lack of accessible sources of nourishment close by, which however does not exclude its concentration here when the human population appears again. An example of initial economic biotopes for Ae. japonicus Theob. may be settlements which spring up in forest territories. Here the numbers and constancy of the mosquitoe is specified by the constant presence of large prey, a sufficient amount of larval biotopes, and even of daytime resting places for the imago phase. In the 19th kilometer from Vladivostok, in the region of the Pervaya and Vtoraya Rivers, Ae. japonicus Theob. is firmly settled close to man in the position of a synanthrope, but the typical forest landscape is just as firmly preserved, and Ae. japonicus Theob. is not distributed further in the adjacent forestless sectors which are settled by man.

The Complete Loss of the Bond Between Aedes togoi Theob. and Aedes japonicus Theob. and the Natural Stations

In 1945 we visited the mountains and large populated points of Korea and Manchuria, where we were able to observe the mass distribution of both species of mosquitoes. If in the unsettled territories of the Soviet Far East we encountered the main settlement of both species in natural stations and saw only the first phases of their formation in the capacity of possible synanthropes, then in the mountains and villages of Manchuria and Korea, and especially Southern Manchuria, they are obligatory and permanent elements of the synanthropic phase. By completely transforming to the position of synanthropes, these mosquitoes lost any bond with their initial natural stations. We found Ae. togoi Theob. at a significant distance from the sea -- in Mukden and Tungliao, and Ae. japonicus Theob. -- in forestless regions; these species are found also in Peiping (Ho, 1931). Apparently in the mountains and settlements of China and Japan both species do not represent a rarity.

Our findings of these mosquitoes in economic stations in Korea and Manchuria are of great interest for a comparison of their rate of occurrence in the unmastered regions of the Soviet Far East. In the port cities of Korea and in the settlements close to them (Yuko, Rasin, Seysin, and others), Ae. togoi Theob. together with Culex vagans Wd. populate all the firefighting tubs, barrels and other artificial water reservoirs along the streets and in outdoor gardens and greenhouses.

Ae. japonicus Theob. is encountered here considerably less often than Ae. togoi Theob. In the large cities of Manchuria -- Mukden and Changchun -- Ae. japonicus Theob. has an especially wide distribution. Out of 110 investigated artificial water reservoirs in Mukden this species was found in 54 (45%), and Ae. togoi Theob. in 12 (10%). More often both species are encountered here together with C. pipiens L. From time to time in their community it is possible to find Aedes albopictus Skuse. In Port Arthur and Dalnem Ae. togoi Theob. is encountered most often. Out of 265 artificial water reservoirs investigated in both cities, Ae. togoi Theob. was detected in 198 (74%), and Ae. japonicus Theob. only in 7 (2.4%). All possible artificial water reservoirs here also serve as breeding places for Ae. togoi Theob., especially the firefighting cement reservoirs on the streets and in the yards. The highest number of larvae and pupae were detected in the city zoological garden in Port Arthur, where each water reservoir was infected with the progeny of both species (Petrishcheva and Chagin, 1945), and also in the city greenhouse. In the last case the tanks with water, which was heated for the watering of the plants, acted as reservoirs. Based on their conditions they were somewhat similar with the natural water reservoirs of the initial stations of Ae. togoi Theob. on the sea shore. Based on their behavior, there is no difference in both species of mosquitoes in the municipal populated zone. They populate all suitable water reservoirs, often living together. As daylight shelters they selected economic structures, often remaining for the day in shaded stations which are rich in vegetation. Their usual source of food was man and domestic animals.

If the settlement of Ae. togoi Theob. in port cities which are found close to the natural stations of this species does not cause particularly great astonishment, then without a doubt attention is drawn to the initial signs of its emergence into the depth of the continent, at a distance of hundreds of kilometers from the primary stations. Ae. japonicus Theob. has torn away for still a greater distance from the forest zone; the possibility is not excluded that its transition to a synanthropic form of life in these places is more ancient, than that of Ae. togoi Theob. On the basis of these data we can with sufficient reliability predict the possibility of the settlement of these species with the further conquering of the Soviet Far East. On the basis of our data it is possible to make practical conclusions concerning the necessity of increasing the sanitation cultivation in the old populated points and of the prophylactic sanitation measures following the mastering of new territories in order to exterminate in the first place, and in the second place to prevent the spreading of certain ectoparasites into economic stations. Along with the conquering of new territories it is also necessary to keep in mind the possibility of spreading, together with the ectoparasites, diseases of the type with a natural focalness, such as cutaneous leishmaniasis, pappatack fever, tularemia, Japanese encephalitis and others.

Main Data on the Vital Activity of Aedes togoi Theob. and Aedes japonicus Theob.

Both in their initial natural stations and following their transition to the condition of a synanthropic insect, both species preserve the main dates for their seasonal activity, which are determined by meteorological factors. By wintering in the egg stage, these mosquitoes have a quite long period during which the larvae and pupae are found in water reservoirs. With Ae. togoi Theob. it is contained in the period from the middle of April up until the end of November, while sometimes the persistant survival of the larvae is observed during their freezing in the water reservoirs at 3/4 the height of the water. From here one can think of the possible wintering of part of the larvae in deeper water reservoirs, especially with a strong concentration of salts. The imago phase of Ae. togoi Theob. is encountered from the second half of May to the middle of October. The greatest numbers of the larval and imago phases of this species in nature belong to the period from July through September inclusively. Often an abundance of larvae is noted during the period of the first ten days of October. In connection with the somewhat lowered temperature regimen of the larval biotopes of Ae. japonicus Theob. in the forest stations, the period for the finding of larvae lasts from the middle of May up to the first days of November. Winged mosquitoes are usually encountered from the first ten days of June up to the middle of October. The period of abundance of the larval and imago phase in nature continues for 2.5 months, usually encompassing the period from the middle of July up to the end of September. We consider that the most dangerous time for the transmission of the Japanese encephalitis virus by these mosquitoes may be 40--50 days, from 15 July through 30 August or through 10 September. At this time in the biotopes of the winged mosquitoes and their larvae the highest temperature regimen is observed which furthers the activity of the mosquitoes and the activity of the virus in their organism.

Conclusions

In the numerous examples of the distribution of Ae. togoi Theob. and Ae. japonicus Theob. in their natural stations in virgin territories of the Soviet Far East and in old cities and villages of Korea and Manchuria, it was possible to establish the gradual transition of these species from the natural stations to a synanthropic form of life. The primary natural station for Ae. togoi Theob. is the rocky sea coast, where this species reaches a high numerical strength in community with sea birds, on whose blood they feed. The rocky, strongly heated pools are larval biotopes.

The initial natural stations for Ae. japonicus Theob. are the taiga forests, where this species never reaches a noticable numerical strength, which is connected with their use of accidental prey.

The appearance of man, even for temporary residence, close to the natural stations of both species of mosquitoes promotes a rapid concentration of them close to man, with a transition to feeding on human blood and with the partial utilization of the dwellings of man for the daytime resting places of the imago phase. The first economic stations for these mosquitoes are the newly emerging populated points (lighthouses on the rocky sea shore, resort settlements in the forest zone, etc.). Under these conditions the mosquitoes almost completely break away from the natural stations, if close to man. In addition to feeding, they find a sufficient number of biotopes which are suitable for the larvae.

In the thickly populated, and ancient in origin, cities of Korea and Manchuria, the complete transition of both species of mosquitoes to the status of synanthropic insects is observed. Apparently this transition was accomplished in the distant past, which is indicated by the complete break of both species from their natural stations. Ae. togoi Theob. is found in Mukden and Tunlyao, which are at a distance of hundreds of kilometers from the sea, on the shore of which their initial natural stations are found.

Ae. japonicus Theob. is widely distributed in the cities of Changchun, Mukden, Tunlyao and in other places which have a forestless flat landscape, and is found at a great distance from the initial forest stations of this mosquitoe.

On the basis of these examples it is possible to predict, with sufficient probability, the possibility of the more rapid settlement of both species in Soviet Primorye following its subsequent economic mastering. This situation places before us the necessity of carrying out a system of general sanitary prophylactic measures during the conquering of new territories, especially in the natural foci of Japanese encephalitis, since with the spreading of these species of mosquitoes there is the possibility of an increase in the danger of the drifting of the pathogenic viruses into the populated points.